

Back to Basics™

BY REBECCA ELLIS AND HOWARD MCKEW

TEST 3 — 100% OUTDOOR AIR HANDLING UNIT ADVANCED ENERGY-EFFICIENT DESIGN

Choose the correct answer (from the choices in bold) for each of the following hvac situations, referring to the schematic diagram on this page.

1 Occupied control, in the "unoccupied" position:

Time-of-day clock (TC-1, TT-4, P-1) shall shut down air handling unit during unoccupied cycle. Outdoor damper D-1 is closed, face and bypass damper D-2 is in the "full face" position. Hot water/steam heating valve is open but under the control of temperature transmitter TT-3 set at 50 F. Chilled water/direct expansion cooling valve is closed and fan motor is off.

2 Occupied-unoccupied control, in the "occupied" position:

Time-of-day programmed clock TC-1 shall signal unit to start. Outdoor damper D-1 is open with end switch ES-1 confirming contact to allow fan motor to be (off, on) at minimum speed via variable speed drive VSD.

3 Maximum cooling:

Bypass damper D-2 is in the (full face, modulating, full by-pass) face position. Heating valve is closed. Cooling valve is open 100% based on room thermostat TT-4 set at 76 F, resetting discharge air temperature transmitter TT-1 signal to maximum cooling set point of 55 F.

4 Minimum cooling:

Bypass damper D-2 is in the "full face" position. Heating valve is (modulating, full closed, full open). Cooling valve modulates towards closing based on room thermostat TT-4 set at 76 F, resetting discharge air temperature transmitter TT-1 signal to minimum cooling set point of 60 F.

5 Free cooling:

Bypass damper D-2 is in the "full face" position. Heating valve is closed. Cooling valve is closed and room thermostat TT-4 set at 76 F is satisfied with (outdoor, return, dis-

charge) air temperature transmitter. TT-1 signal is also satisfied based on cool outdoor air maintained at setpoint of 55 F. (See 'Helpful Hints' next page.)

6 Minimum heating:

Bypass damper D-2 is in the "full face" position. Heating valve modulates open, based on room thermostat TT-4 set at 76 F, resetting discharge air temperature transmitter TT-1 signal to minimum heating to maintain set point of 60 F and cooling valve is (modulating, full closed, full open).

7 Maximum heating:

When outdoor air temperature drops below 38 F based on temperature transmitter TT-2, heating valve shall open (100%, 50%, 0%) and bypass damper D-2 shall modulate to "bypass," based on room thermostat TT-4 set at 76 F, resetting discharge air temperature transmitter TT-1 signal to maximum heating to maintain setpoint of 60 F and cooling valve is closed.

8 Variable speed drive control:

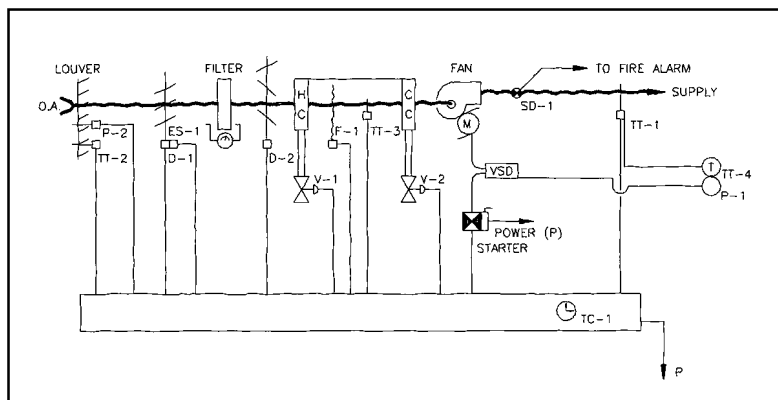
Space "positive pressure" shall be maintained at 0.05 inches water gage. Differential pressure transmitter with P-1 space high-side setpoint and P-2 outdoor air low-side setpoint shall vary the speed of the fan motor VSD from (minimum, nominal, maximum) speed at start-up to maximum supply air to maintain room pressure. When space pressure is satisfied, VSD shall slow the fan speed towards low flow.

9 Alarms controls:

Freeze-stat F-1 set at 38 F shall shutdown fan motor and system components will go to their "fail safe" positions which are: outdoor damper D-1 is (modulating, full closed, full open), face and bypass damper D-2 is in the "full face" position, heating valve is open, cooling valve is closed, and fan motor is off. Manual reset of system will be required to restart the system.

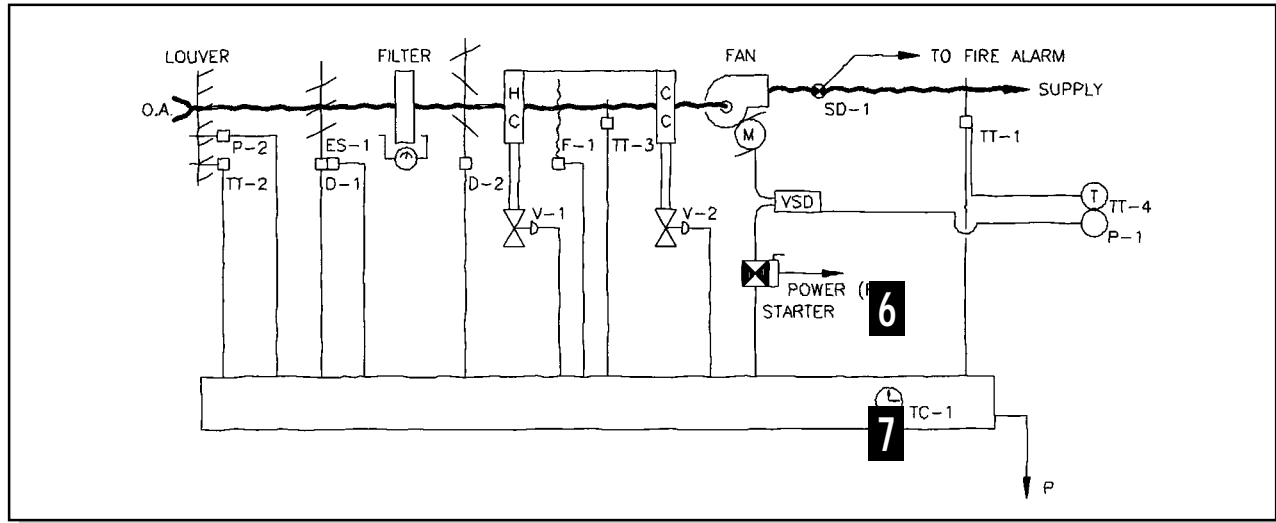
10

Duct smoke detector shall shutdown fan motor, signal an alarm condition to the fire alarm system, and system components will go to their "fail safe" positions which are: outdoor damper D-1 is closed, face and bypass damper D-2 is in the "full face" position, heating valve is open, cooling valve is (modulating, full closed, full open) and fan motor is off. Manual reset of system will be required to restart the system.



ANSWERS FOR ADVANCED SYSTEM — COMMISSIONING: 1 a) stops; 2 a) minimum; 3 a) 55 F; 4 a) 60 F; 3 b) open; 4 a) 55 F; 4 c) less than; 5 a) increases; 6 a) decreases; 7 a) occupied. (If you have any questions regarding the Advanced System - Commissioning test, fax your concerns, questions, and/or comments to: Rebecca Ellis, P.E., 612-546-0494.)

TEST 4 — 100% OUTSIDE AIR HANDLING UNIT ADVANCED ENERGY-EFFICIENT DESIGN — COMMISSIONING



Choose the correct answer (from the choices in **bold**) for each of the following hvac situations, referring to the schematic diagram on this page.

- 1** Put system into unoccupied mode via timeclock TC-1 and verify that:
 - a) Fan (starts, stops).
 - b) Outside air dampers D-1 close.
 - c) Face and bypass dampers D-2 open to full face position.
 - d) Heating valve V-1 (closes, opens, modulates).
 - e) Cooling valve V-2 closes.
- 2** Put system into occupied mode via timeclock TC-1 and verify that:
 - a) Fan starts at (maximum, minimum) speed.
 - b) Outside air dampers D-1 open.
- 3** Reset room temperature setpoint 4°F higher than current room temperature (TT-4) reading and verify that:
 - a) Heating and cooling valves (V-1 and V-2) modulate in sequence to maintain (60°F, 55°F) discharge air temperature (TT-1).
 - b) Face and bypass dampers D-2 (open, close) to full face position if outside air temperature (TT-2) is greater than 38°F.
 - c) Face and bypass dampers D-2 modulate to maintain discharge air temperature (TT-1) setpoint if outside air temperature (TT-2) is less than 38°F.
- 4** Reset room temperature setpoint 4°F lower than current room temperature (TT-4) reading and verify that:
 - a) Heating and cooling valves (V-1 and V-2) modulate in sequence to maintain (60°F, 55°F) discharge air temperature (TT-1).
 - b) Face and bypass dampers D-2 open to full face position if outside air temperature (TT-2) is greater than 38°F.
 - c) Face and bypass dampers D-2 modulate to maintain discharge air temperature (TT-1) setpoint if outside air temperature (TT-2) is (greater than, less than) 38°F.
- 5** Reset differential pressure setpoint to 0.05 in. wg higher than the current differential pressure (P-1) reading and verify that:
 - a) The VSD (increases, decreases) speed to achieve setpoint differential pressure.
- 6** Reset differential pressure setpoint to 0.05 in. wg lower than the current differential pressure (P-1) reading and verify that:
 - a) The VSD (increases, decreases) speed to achieve setpoint differential pressure.
- 7** Return space differential pressure (P-1) setpoint and space temperature (TT-4) setpoint to original values and verify that:
 - a) System resumes normal (occupied, unoccupied) operation.

HELPFUL HINTS:

When advancing the sequence of operations design, control setpoints need to be clearly defined. For example, a discharge air reset schedule, noted above, should be added to the sketch as follows:

- Space temperature 77°F or above; discharge air = 55°F.
 - Space temperature 75°F to 77°F; discharge air = 60°F to 55°F.
 - Space temperature 75°F or less; discharge air = 60°F.
- Free-cooling occurs when outdoor air = discharge air (which can vary between 55°F and 60°F).